PATENT
Atty Docket KLAC0016

#11
4-29-03
CBrown

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	Group Art Unit: 2877
DIETER MUELLER ET AL.	Examiner: Hwa S. Lee
Title: REDUCED COHERENCE SYMMETRIC GRAZING INCIDENCE DIFFERENTIAL INTERFEROMETER	
Serial No.: 09/543,604	
Filed: April 7, 2000	

DECLARATION UNDER 35 C.F.R. 1.131

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

We, Dieter Mueller, Daniel Ivanov Kavaldjiev, and Rainer Schierle, do hereby declare as follows:

1. We are coinventors of currently pending claims 1-23 of the above-identified patent application.
2. Prior to June 3, 1999, we conceived of the idea of a Reduced Coherence Symmetric Grazing Incidence Differential Interferometer as described and claimed in our application. Conception and all acts described herein occurred in WTO countries.
3. Rainer Schierle prepared drawings and entered passages in his notebook of certain aspects of the invention reflected in the aforementioned currently pending claims. A copy of relevant portions of the notebook prepared by Mr. Schierle ("the Notebook") is attached hereto as Exhibit A.

4. Specifically, the Notebook shows the "double mirror" concept conceived by us and the dual sided inspection of a specimen, such as a semiconductor wafer. At the top of the first page, each side of the two sided specimen is parallel to a reflecting surface, such as a mirror, and illumination is directed toward the specimen and both reflective surfaces.

5. Further evidence of conception prior to June 3, 1999 is illustrated in Exhibit B, a report prepared by inventor Rainer Schierle showing simulated results for particular arrangements of a specimen inspection system. In particular, the letters "DM" indicate a "double mirror" design such as that illustrated in the Notebook. The documents presented in Exhibit B were prepared by Rainer Schierle prior to June 3, 1999.

6. Subsequent to conception but prior to June 3, 1999, we began exploring various designs intended to produce improved scanning of semiconductor wafers. We explored different inspection designs, including performing an analysis of at least two designs. We eventually concluded that a reduced coherence design could offer benefits not found in certain non-reduced coherence designs. With the assistance of certain persons employed by KLA-Tencor Corporation, we began analyzing, working on, and constructing a prototype of the reduced coherence design.

7. We and others employed by KLA-Tencor Corporation began working on and constructing a device including the reduced coherence design prior to June 3, 1999. We procured various pieces prior to June 3, 1999 for use in the low coherence prototype.

8. We worked together in building the design, including placing a semiconductor wafer in a measurement cell along with two mounted mirrors similar to the design presented in the top portion of FIG. 1B of U.S. Patent Application Serial No. 09/543,604 and taking measurements of the wafer using the reduced coherence prototype. On information and belief, completion of construction of the reduced coherence prototype and measurement of a two sided semiconductor wafer using the reduced coherence prototype occurred either shortly before or shortly after June 3, 1999.

9. Attached hereto as Exhibit C is an email from Daniel Kavaldjiev to Dieter Mueller and Rainer Schierle dated July 30, 1999. The email includes two scans

of actual semiconductor wafers, one employing a diffuser and the other with the diffuser off. Both of these scans were produced using the reduced coherence prototype.

10. Based on the email of Exhibit C, we reduced the reduced coherence invention to practice before July 30, 1999. Our efforts from the period prior to June 3, 1999 to actual reduction to practice included procuring parts for the reduced coherence prototype, setting up the reduced coherence prototype including placing mirrors in the measurement cell, setting other components in the measurement cell including the gratings, and testing the design.

The undersigned, being hereby warned that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of any application or patent issuing therefrom, declares that the facts set forth in this declaration are true, and that all statements made of his own knowledge are true and all statements made on information and belief are believed to be true.

Dated: April 17, 2003

Dieter Mueller

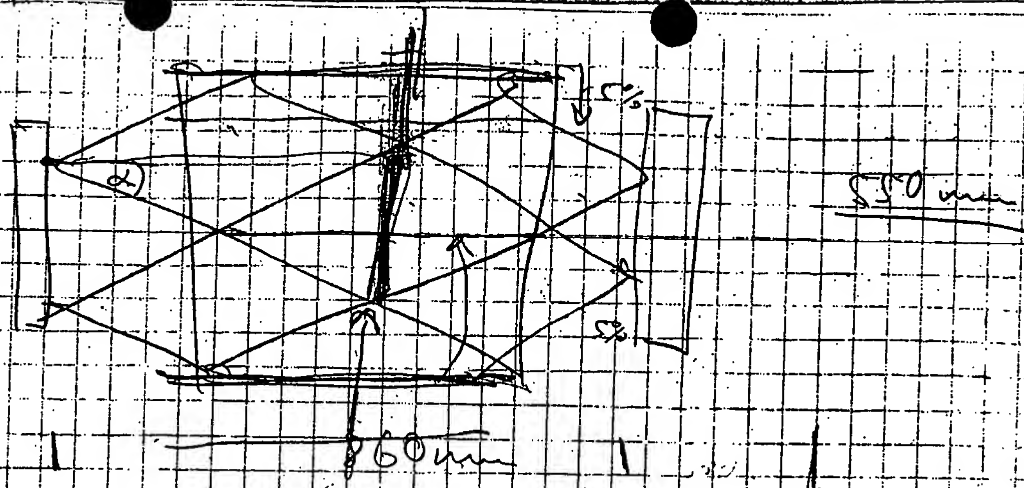
Dated: April 17, 2003

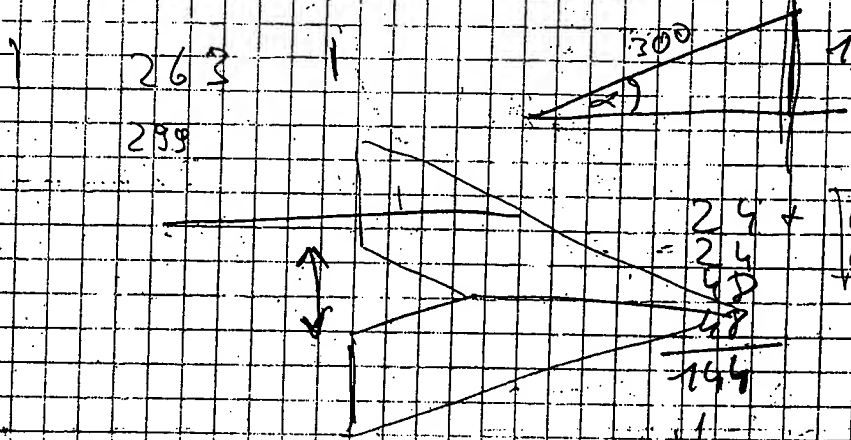
Daniel Ivanov Kavaldjiev

Dated: April 17th, 2003

Rainer Schierle

EXHIBIT A

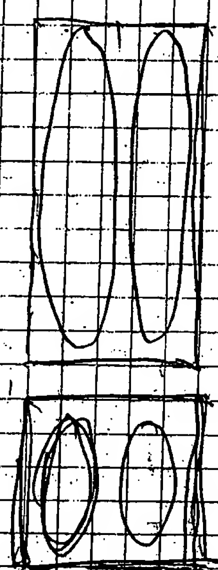


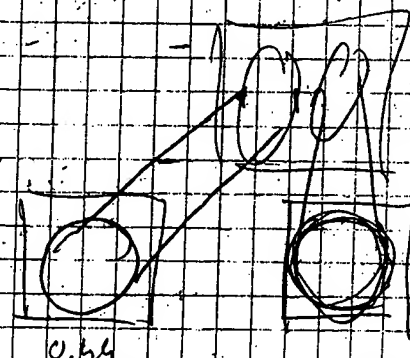


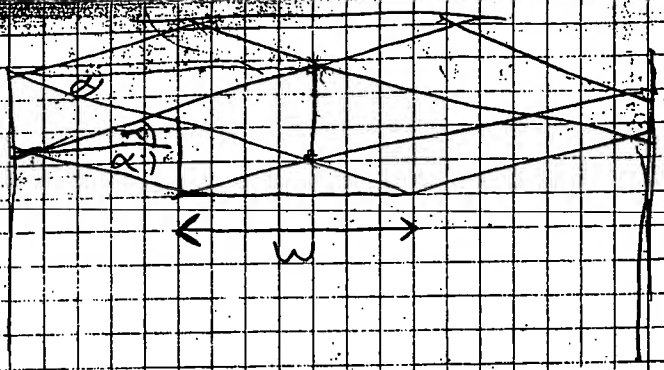
24 +
24
48
48
144

0.440
0.147

Hamamatsu







$\alpha = 9.105°$ 300 mm

Bildbreite: 48.08 mm

Luftspalt = 2 mm pro Seite

52 mm $\Rightarrow$ Mindestlänge von Welle = 52/tan α = 324.46 mm

$\frac{s}{x} = \tan\alpha \quad x = \frac{s}{\tan\alpha}$

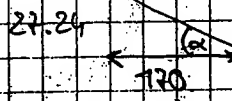
- Gitterabstand = 320 mm

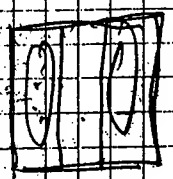
$\Rightarrow (321.28 - 48)/2 =$ 136.6 mm Spaltbreite

- Falls 1 & 2:

Mindest Breite = 27.24 × 2 + 48.08 × 2 = 150.61

bei 0. Ordnung





Mindestbreite bei 3. Ordnung = 161.8

Gitterbreite = 165 mm

Pixel Dim = $2048 \times \frac{48.08}{11.5} = 8796.77$

Pixelsize = 0.8022 mm

Pixelsize = 0.15 mm

EXHIBIT B

Summery of Design Criteria for LS3 Topo

Camera	Z points	Y points	Frames per se	Resolution [bit]
	1024	1024	2.1	8

Laser	[um]
Wave Length	0.633

Scan Matrix

	Camera 1	Camera 2	Camera 3
Y Images	1	1	0
Z Images	1	1	0

Order of Diffra	tan(Angle)
1	0.160263554
2	0.333625236
3	0.539345391

Systems

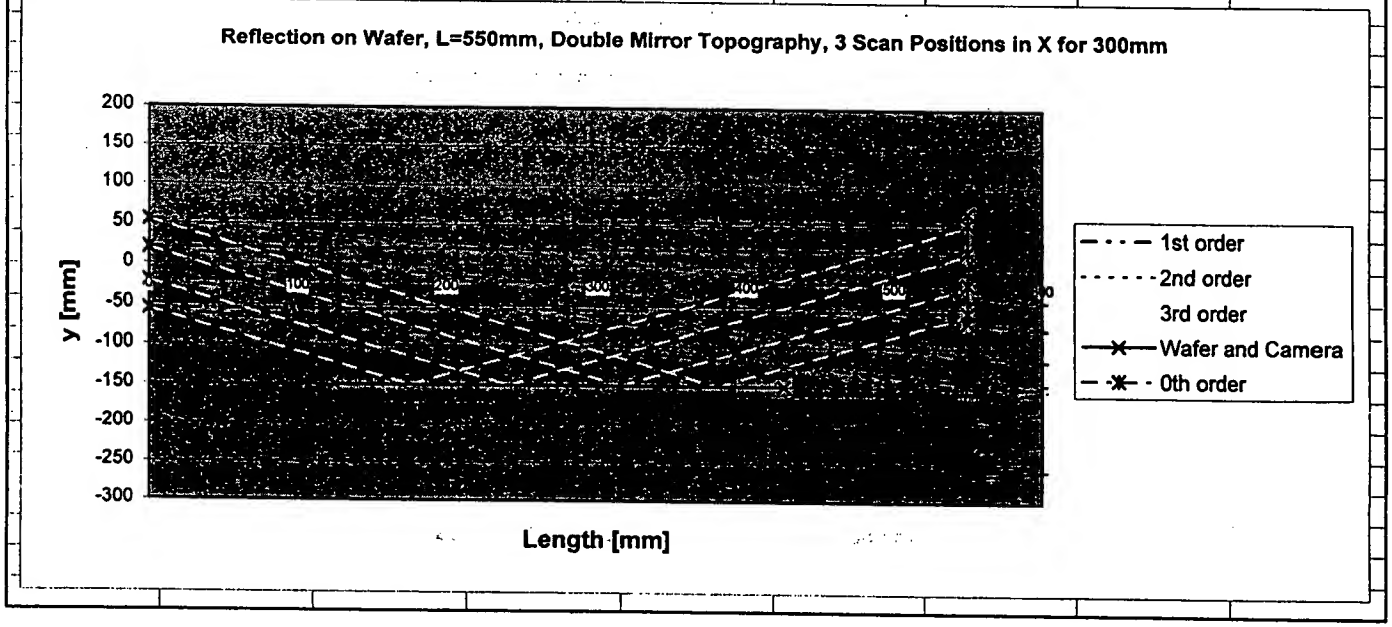
Geometry	Topo	Design	**General** G1 - G2	Grating Size Y	Grating Use Y	Grating Use Z	**Geometry Mode** Width of Image	Width Grating	Z Res [nm]	Pixel Y [um]
300	200	RD	550	140	138	302	48.08		7.81	0.420
300	200	DM	640	140	138	302	48.08	150.6477404	7.81	0.420
300	300	RD	800	182	178	302	48.08		7.81	0.542
300	300	DM	800	182	178	302	48.08	176.289909	7.81	0.542
200	200	RD	550	140	124	202	32.05		7.81	0.378
200	200	DM	550	140	124	202	32.05	120.1976652	7.81	0.378

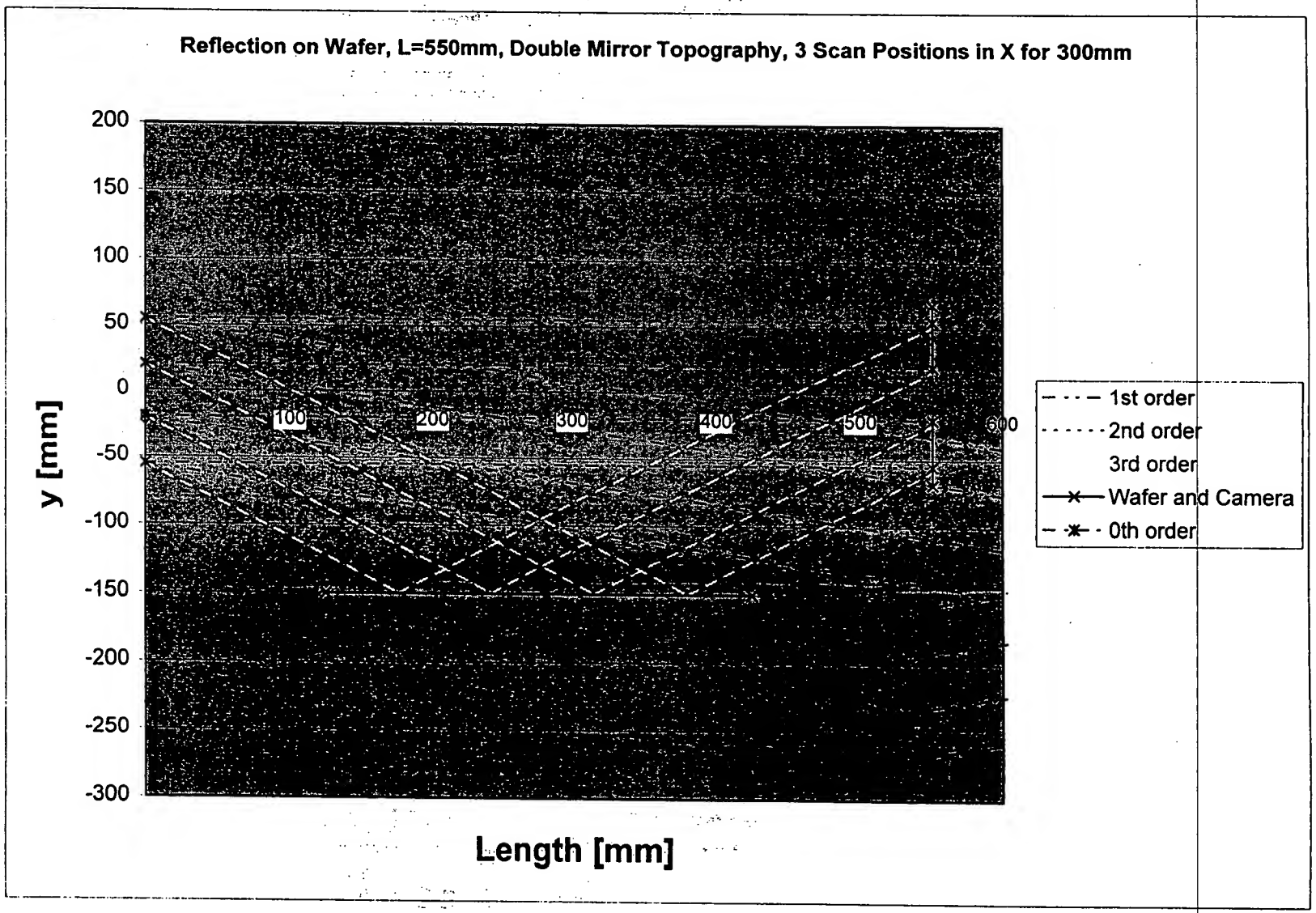
Summery of LS3 Topo Design

Topo Mode

Pixel Z [um]	Acq. Time	Analysis Time	Width of Image	Z Res [nm]	Pixel Y [um]	Pixel Z [um]	Acq. Time	Analysis Time
0.147			107.87	2.60	0.125	0.147		
0.147			107.87	2.60	0.125	0.147		
0.147			161.80	2.60	0.161	0.147		
0.147			161.80	2.60	0.161	0.147		
0.099			107.87	2.60	0.112	0.099		
0.099			107.87	2.60	0.112	0.099		

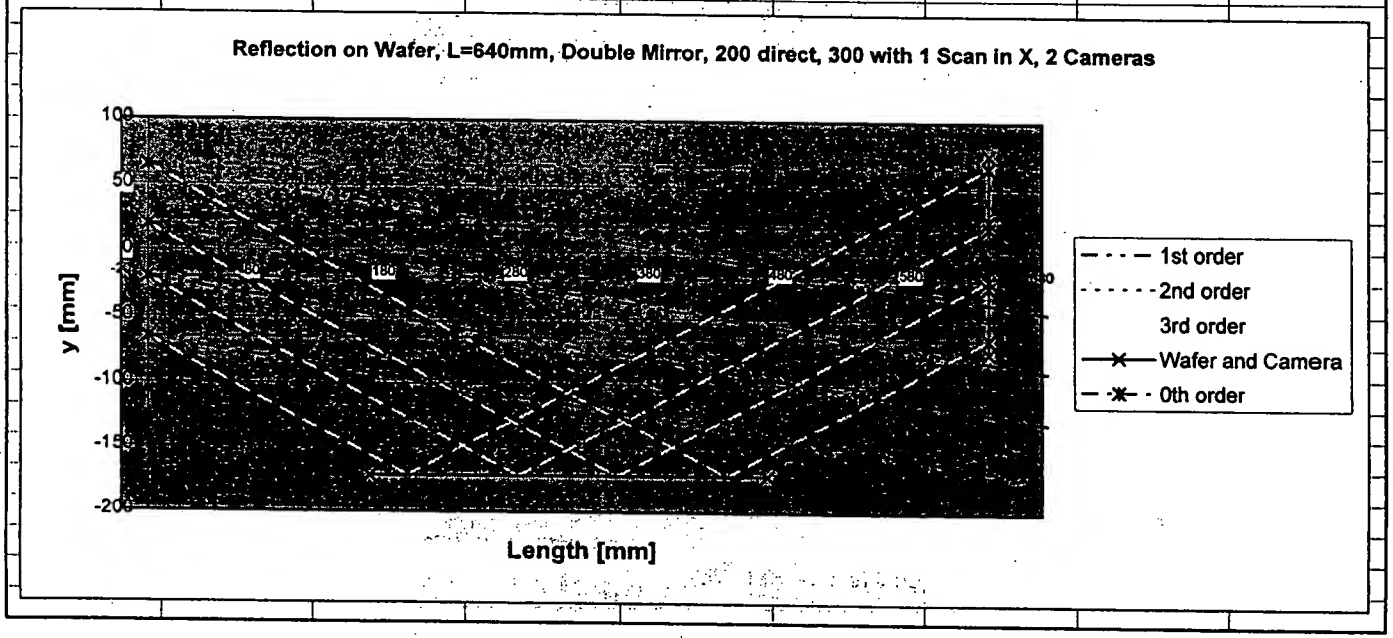
Reflection on Wafer		Model	550DMT					
Length	Wafer Position	Wafer Length	tan alpha	tan beta	tan gamma	WaferInUse	G2InUse	TopMirrorInUs
550	-150	300	0.160263554	0.333625236	0.539345391	1	1	1
								Position
Points	X Min	X Max	P1 X	G2 Y1	P2 X	G2 Y2	P3 X	G2 Y3
20.03	125	425	1060.94	-231.89	509.64	-136.54	315.25	-23.39
55	125	425	1279.14	-266.86	614.46	-171.51	380.09	-58.36
20.03	125	425	1060.94	-231.89	509.64	-136.54	315.25	-23.39
20.03	125	425	1060.94	-231.89	509.64	-136.54	315.25	-23.39
20.03	125	425	1060.94	-231.89	509.64	-136.54	315.25	-23.39
-20.03	125	425	810.98	-191.83	389.57	-96.48	240.98	16.67
-55	125	425	592.77	-156.86	284.75	-61.51	176.14	51.64

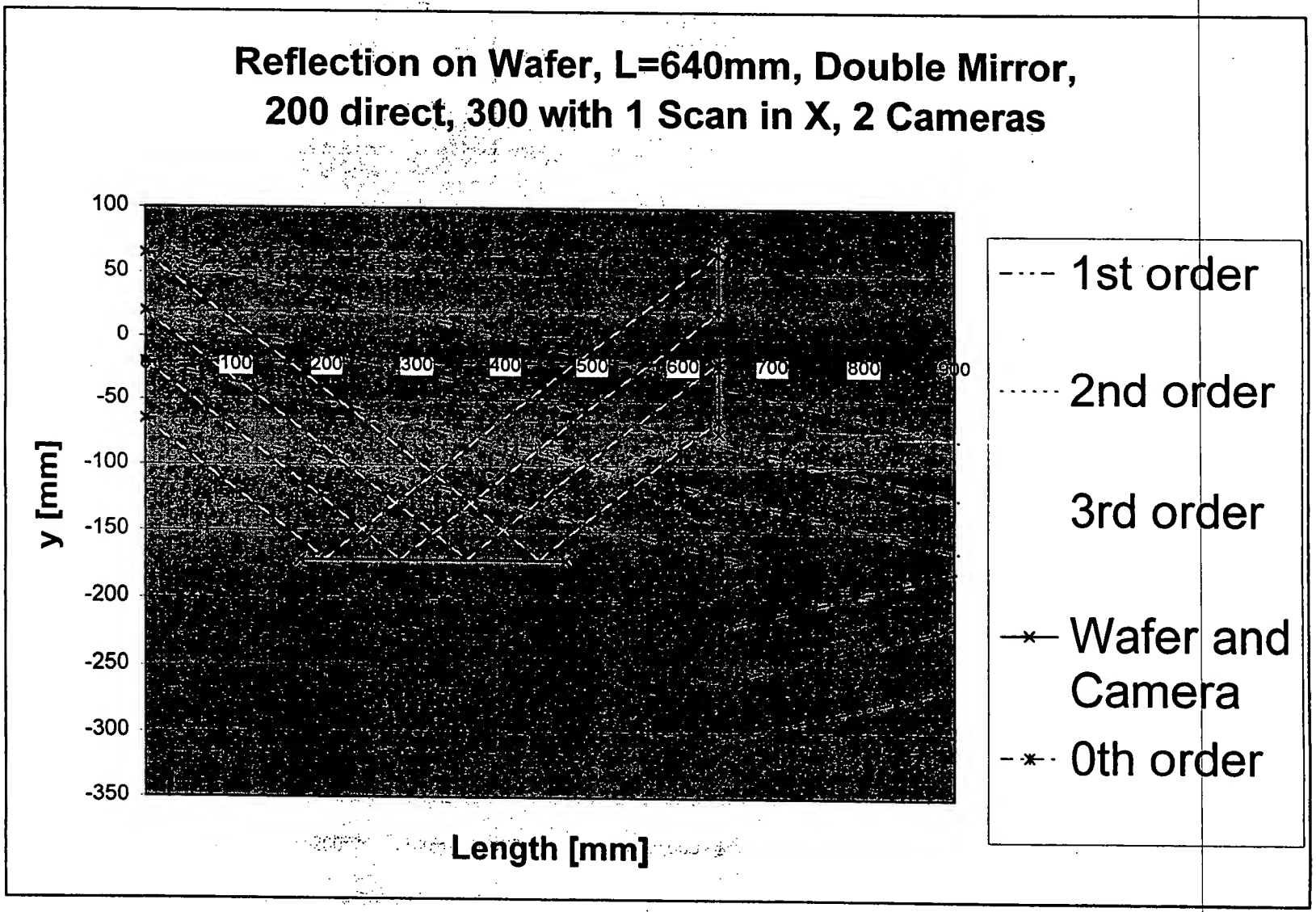



Reflection on Wafer, L=550mm, Double Mirror Topography, 3 Scan Positions in X for 300mm
200
150
100
50
0
-50
-100
-150
-200
-250
-300
y [mm]
100
200
300
400
500
600
Length [mm]
1st order
2nd order
3rd order
Wafer and Camera
0th order

Tab1

Reflexion on Wafer		Model	640DMT2CXS					
Länge	Wafer Position	Wafer Length	tan alpha	tan beta	tan gamma	WaferInUse	G2InUse	TopMirrorInUs
640	-172	300	0.160263554	0.333625236	0.539345391	1	1	1
								Position
Punkte	X Min	X Max	P1 X	G2 Y1	P2 X	G2 Y2	P3 X	G2 Y3
65	170	470	1478.81	-306.43	710.38	-195.48	439.42	-63.82
-65	170	470	667.65	-176.43	320.72	-65.48	198.39	66.18
65	170	470	1478.81	-306.43	710.38	-195.48	439.42	-63.82
65	170	470	1478.81	-306.43	710.38	-195.48	439.42	-63.82
65	170	470	1478.81	-306.43	710.38	-195.48	439.42	-63.82
-20	170	470	948.44	-221.43	455.60	-110.48	281.82	21.18
20	170	470	1198.03	-261.43	575.50	-150.48	355.99	-18.82




Reflection on Wafer, L=640mm, Double Mirror,
200 direct, 300 with 1 Scan in X, 2 Cameras
100
50
0
-50
-100
-150
-200
-250
-300
-350
y [mm]
100
200
300
400
500
600
700
800
Length [mm]
1st order
2nd order
3rd order
Wafer and Camera
0th order

From: Kavaldjiev, Daniel [Daniel.Kavaldjiev@kla-tencor.com]
Sent: Friday, July 30, 1999 5:41 PM
To: Mueller, Dieter; Schierle, Rainer
Subject: diffuser effect

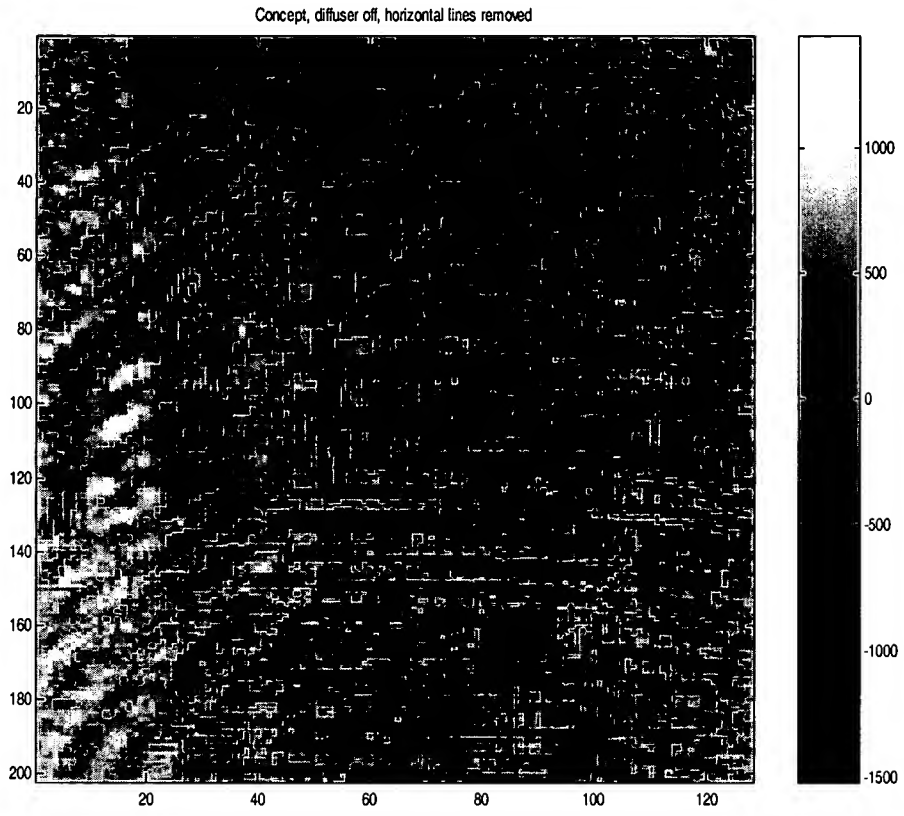
Dieter, Reiner,

Included is a word file with two pictures of 30 nm pattern wafer measured with and without the diffuser. Both images are filtered for the horizontal lines from the camera.

Regards,
Dan

Concept, 30 nm pattern wafer measurement

Diffuser off, horizontal lines removed



Diffuser on, horizontal lines removed